Worked Example: The Trapezoidal Rule

The *trapezoidal rule* is a numerical integration scheme in which the area under a curve is approximated by a collection of trapezoidal subdivisions whose individual areas are added together. Consider the integral of some function $f(x)$ over the limits from $x = a$ to $x = b$. If this integral is to be approximated by N trapezoidal divisions, then the approximate value of the integral is given by:

$$\int_{x=a}^{x=b} f(x)\,dx \cong -\frac{\Delta x}{2}\cdot\left[f(a) + f(b)\right] + \Delta x \cdot \sum_{i=0}^{i=N} f(a + i\cdot\Delta x)$$

The parameter Δx is the assumed uniform width of the divisions:

$$\Delta x \equiv \frac{b-a}{N}$$

Using the formulation above, create a VI to approximate the integral of the function $f(x) = x + 2x\cdot\cos(x^2)$, between any two limits a and b, and for any desired divisions N. Note that in general, numerical integration techniques are most practical for use when the exact answer is otherwise indeterminate, or for fundamentally discrete data.